motion in their relation to the time. The account that is given of the labours of Italian observers in the field of microseismometry is meagre and unsatisfactory, and the work of M. d'Abbadie and the Darwins in this connection is not so much as alluded to.

The only part of M. Fouqué's book which can be said to make any addition to existing knowledge is that which deals with the experiments conducted by the author and M. Michel Lévy on the speed of propagation of artificial disturbances through the earth's crust. In the first instance their method was the same as that used by Mallet and by Abbot; the seismoscope was a basin of mercury, in which the observer detected the arrival of the shock by watching in a telescope for the disturbance of the reflected light. In a second series of experiments, the personal equation of the observer was got rid of by causing a convergent pencil of light reflected from the basin to fall on a revolving photographic plate. The light was intercepted by a shutter which opened, through electric connection with a seismoscope at the origin of the shock, when the blow was given which caused the disturbance to be propagated. Then, until the arrival of the earth waves blurred the image, a sharply defined circular arc was photographed on the plate, the length of this arc serving to measure the time of transit of the waves. In other instances, where the explosion of dynamite formed the source of disturbance, the explosion was produced by an electric discharge which was made to photograph itself on the plate, thus registering the instant at which the disturbance originated more sharply than by the method of the shutter. Besides observations on the surface of the ground in various localities, and with various qualities of vibrating medium, some were made entirely underground. The author and his colleague made use for this last purpose of a mine at Commentry, by causing the explosion to take place in one gallery, 470 feet below the surface, while the seismoscope was set first on the surface of the ground and then in a second gallery 280 feet below the other. As a general result, it was noticed in all cases that the first thing to reach the seismoscope was a series of very small vibrations, which preceded the arrival of the principal shock. In surface propagation this principal shock was not unique: it was followed by several others, although the initial disturbance at the distant source had consisted in a single blow.

Notwithstanding the care and pains which have evidently been bestowed on the author's experiments, the results, as regards speed of propagation of seismic waves, seem to be subject to some uncertainty. The intervals of time actually measured were too small, and what may be called the personal equation of the apparatus was too large. The whole amount by which the record lagged through inertia of the apparatus and other causes is estimated to be 0·301 seconds. Taking one set of experiments (at Creuzot), the recorded time-interval, when the seismoscope was 490 metres from the source, was 0·105 seconds; but to this small quantity we have to add the above large error of 0·301 seconds before deducing the velocity. It should be added, however, that observations made at a more distant station gave results according well with the velocity so deduced. The velocities ranged from about 3000 metres per second in granite to 300 metres per second in sand. The results as to rocky soils are of the same order of magnitude with those of Abbot, and with the velocities which have been inferred from laboratory experiments on the density and elasticity of rocks. The figures given refer to the rate of propagation of the group of waves, as measured by the arrival of the first sensible motions—the motions, namely, which form the advancing edge of the group. But the group widens as it travels, and a much smaller speed would be deduced by reference to the passage of the principal wave or waves.

The first and main part of M. Fouqué's book, entitled "A General Study of Earthquakes," concludes with an interesting detailed account of these experiments. The second part will appeal to a wider circle of readers. It is a narrative of the principal earthquakes which have been felt from 1854 to 1887, including those of San Salvador in 1854, 1873, and 1879; of Simoda, in Japan, in 1854; of Ischia in 1883; of Andalusia in 1884; and of the Riviera in 1887. The account is pleasantly written, and is embellished by a number of photo-engravings showing the mischief wrought by these destructive shocks.

PERIPATUS.

Studies from the Morphological Laboratory in the University of Cambridge. Vol. IV.—Part 1. A Monograph of the Development of *Peripatus capensis.* Part 2. A Monograph of the Species and Distribution of the Genus *Peripatus.* By Adam Sedgwick, M.A., F.R.S. (London: 1888.)

IN these two numbers the editor has reprinted the five papers from his pen on *Peripatus*, which have appeared in the *Quarterly Journal of Microscopical Science* between 1885 and 1888. From the patient detail with which he has followed the developmental changes, and from the power of generalization from observation which he displays, this research may well be regarded as a model for those who are beginning embryological study. Memoirs such as these, on the other hand, are rarely distinguished for clearness of expression and lucid phrasing, and the one before us forms unfortunately no exception to the generality.

Since the observations of Moseley and Balfour, it has been anticipated that several difficult morphological problems presented by the Arthropoda would receive their solution from a study of the ontogeny of *Peripatus*, and in Mr. Sedgwick's hands this hope has been largely realized. The only other recent workers in this field, Miss Sheldon, Mr. Sclater, and Dr. von Kennel, have studied forms from New Zealand and the West Indies; and while the observations of the latter are in many points at variance with those before us, some of the disagreement is undoubtedly due to the different development of the different species. Like most of such primitive types, the species of *Peripatus* are widely and discontinuously scattered, and exhibit considerable structural and embryological discrepancy. Such a discrepancy occurs at the outset. The ovum of the New Zealand form is large, and consists mainly of deutoplasm; that of the Cape species, the subject of the present memoir, is smaller, and, while now actually devoid of yolk, forms a loose reticulum of protoplasm which appears to imply its former presence between the meshes: in both of these

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segmentation is meroblastic. The ova of the West Indian *Peripatus*, again, are yet smaller, and totally devoid of yolk, and the segmentation is apparently complete. In other words, the reduction in size of the ovum, due to loss of yolk, which is still in process in *P. capensis*, has been achieved in the West Indian forms, and its effect shows how easily the phylogenetic significance of segmentation-types may be lessened.

We can only mention a few of the more important facts and generalizations of Mr. Sedgwick's memoir. Of great interest is the observation that the embryo, at any rate at and until the gastrula stage, is a syncytium, *i.e.* the various cells of which it is composed are only incompletely marked off from one another, being connected by radiating protoplasmic strands. Such a syncytial condition the author regards as more primitive than the complete separation of the segmentation-spheres from each other. Another point in the early ontogeny is that no part of the nucleus of the unsegmented ovum enters that central portion of the syncytium which becomes differentiated into endoderm; and in this connection some recent observations of Hickson on segmentation in *Millepora* are of value. The ovum in *Millepora* is almost devoid of yolk, while those of the Hydrozoa generally possess a large quantity; and we venture to think that an earlier yolked condition probably occurred in *Millepora*, though Mr. Hickson has pronounced to the contrary. The segmentation-nucleus breaks down into a number of deeply-staining fragments, which become scattered through the cell, and eventually arrange themselves as the nuclei of the blastula; and it is at any rate possible that a similar phenomenon occurs in the formation of the endoderm of *Peripatus*, since Mr. Sedgwick describes (p. 26) "small particles of a deeply-staining matter, which are neither visible in the unsegmented ovum nor in the gastrula stages, and which are not to be distinguished from nuclear chromatin." From whatever source, amitotic nuclei presently appear in the endodermal vacuolated protoplasm, and the enteron is formed by the confluence of these vacuoles. A solid gastrula is thus produced. These facts lead Mr. Sedgwick to discuss the course of the evolution of Metazoa from Protozoa. He pronounces in favour of a "nucleated Infusorian-like animal, with possibly a mouth leading into a central vacuolated mass of protoplasm," for the transition-type, as against a colonial Protozoan; and declines to accept Metschnikoff's hollow blastula as an even more primitive form than the solid gastrula.

The nephridia, the existence of which is one of the most remarkable features of *Peripatus*, present two special modifications, those of the third somite becoming the salivary glands of the adult, and those of the twenty-first functioning as generative ducts. The generative glands themselves are formed as two continuous tubes from the dorsal sections of somites 16-20 by a separation from the ventral sections and absorption of the septa. With reference to the cœlom, Mr. Sedgwick comes to several important conclusions. The mesoblastic bands appear as a proliferation of nuclei at the lips of the blastopore, which arrange themselves in groups round a succession of cavities to form the future somites; a mode of connection generally taken to imply an obscured enterocœle. This primary enterocœlic system of cavities is represented in the adult merely by the generative glands and the nephridia; the latter are, as the author insists, not connected with, but actual parts of, the cœlom, and open each into a hitherto undescribed vesicle in the leg, which at no period communicates with the perivisceral space. Heart, pericardium, and perivisceral cavity are the outcome of spaces *secondarily* excavated in the mesoderm in connection with a vascular system, and are best designated by Lankester's term hæmocœle. Such a hæmocœle is characteristic of Mollusca and Arthropoda, and Mr. Sedgwick's deductions tend to show that in the latter group also the generative glands and ducts and the excretory antennary glands are the sole remnants of the true cœlom.

In the second part, which deals with the genus from a systematic stand-point, Mr. Sedgwick criticizes the various forms hitherto described. He recognizes nine good species, of which two are new: four from South Africa, two from the Australian region, and three from the Neotropical. The coloured plates which illustrate this section are most creditable to the lithographers of the Cambridge Scientific Instrument Company. In future volumes of the "Studies" an *exact* reference to the place where the original paper is to be found would often spare trouble to the student of zoological literature.

THE TEACHING OF CHEMISTRY.

The Fundamental Principles of Chemistry practically taught by a New Method. By Robert Galloway, M.R.I.A., F.C.S. (London: Longmans, Green, and Co., 1888.)

THE first thing that strikes one in taking up this volume is that it requires cutting. This is a considerable drawback to the student working from it, especially in those cases where the description of an experiment is continued on the next page, and to the mere reader it involves a trouble that ought not to be imposed upon him. But a far more serious fault is the absence of even an attempt at an index. Whether the author, the publisher, or the binder is to blame for this omission is not obvious, but the fact remains that the book is incomplete.

The difficulty as to where the beginner shall begin must have presented itself in some form or other to every earnest teacher. Shall the facts come first in their then necessarily isolated condition? or shall the student begin with theories, making for himself so many mental pigeon-holes into which the facts as they come may be put away in an orderly manner?

The majority of teachers at the present day prefer to have something to classify before they attempt a classification with their pupils, and in so doing we think they adopt a perfectly sound and natural method. The earnest student is anxious to get on from the very first day of his course, he craves to get hold of something tangible; and the teacher who treats him like an empty reservoir, that is to be elaborately prepared and carefully tested as to perfection of soundness before any water is admitted to it, will ignominiously fail.

Probably every teacher of chemistry has found difficulty

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